


# **EXHIBIT I**


**Exemplary Infringement Chart for U.S. Patent No. U.S. Patent No. 9,714,512**


Reflective roof granules produced by Amberger Kaolinwerke, including but not limited to the AKCool Solar Reflective Granules, (“AKW Products”) infringe, by way of at least contributory and induced infringement, the asserted claims of U.S. Patent No. 9,714,512 (the “’512 Patent”). Each of the following limitations is met literally, and, to the extent a limitation is not met literally, it is met under the doctrine of equivalents.

This claim chart is based on the information currently available to U.S. Silica. Such information is intended to be exemplary in nature with respect to a representative product. U.S. Silica reserves all rights to update and elaborate upon its infringement positions, including the right to amend its infringement positions as U.S. Silica obtains additional information in discovery concerning the AKCool Solar Reflective Granules or other products that may infringe the asserted claims or other claims of the ’512 Patent.

<b>Claim 1</b>	
<b>’512 Patent Claim</b>	<b>AKW Products</b>
1[pre] A cool roofing system comprising:	<p>The AKW Products are intended to be incorporated into a cool roofing system. The AKW Products are incorporated into cool roofing systems by AKW customers, who are manufacturers of such systems.</p> <p>“The invention relates to a roof coating comprising a bitumen layer with embedded particles.” ’947 Patent, Abstract.</p> <p>The AKW Products, including AKCool® patented Solar Reflective Granules, are incorporated into “cool roofing systems” and are “specially developed for bitumen mineral cap sheets used on roofs.”</p>


Claim 1			
'512 Patent Claim	AKW Products		
	 <b>AKCool® – PATENTED TECHNOLOGY</b> <p>The new, patented AKCool® granules are specially developed for bitumen mineral cap sheets used on roofs. The product is characterized by <b>permanently high reflectance values and especially long durability</b>. As a result, AKCool® helps lower building temperatures, minimize energy and operating costs, and meet building environmental standards.</p> <table border="0"> <tr> <td> <b>Optimized granules:</b> <ul style="list-style-type: none"> <li>→ Completely reflective (due to reflective core material)</li> <li>→ Optimized flaked granule shape and ideal particle size distribution for perfect coverage and fixation</li> <li>→ High hardness</li> <li>→ Minimal fines, low dusting</li> <li>→ Absolutely UV-resistant</li> </ul> </td><td> <b>Optimized surface:</b> <ul style="list-style-type: none"> <li>→ Minimum staining thanks to highly hydrophobic and oleophobic surface</li> <li>→ Long-term durability of granules brings long-term reflectance to the roof system</li> <li>→ Perfect adhesion to bitumen surface due to microporous flake surface</li> </ul> </td></tr> </table>	<b>Optimized granules:</b> <ul style="list-style-type: none"> <li>→ Completely reflective (due to reflective core material)</li> <li>→ Optimized flaked granule shape and ideal particle size distribution for perfect coverage and fixation</li> <li>→ High hardness</li> <li>→ Minimal fines, low dusting</li> <li>→ Absolutely UV-resistant</li> </ul>	<b>Optimized surface:</b> <ul style="list-style-type: none"> <li>→ Minimum staining thanks to highly hydrophobic and oleophobic surface</li> <li>→ Long-term durability of granules brings long-term reflectance to the roof system</li> <li>→ Perfect adhesion to bitumen surface due to microporous flake surface</li> </ul>
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	 <b>SAVE.</b> <ul style="list-style-type: none"><li>→ Less energy needed for cooling, reduces energy costs and minimizes CO<sub>2</sub> emission</li><li>→ Robust and durable, reduces operating and maintenance costs</li><li>→ Counters the urban heat island effect, improving the microclimate in urban areas</li><li>→ Helps meet ever-stricter environmental standards for buildings in terms of energy savings</li><li>→ An important factor for LEED sustainability certification</li></ul>

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	 <p>The advertisement for AKCool features the title 'AKCool® – QUALITY MADE IN GERMANY' at the top. Below the title, on the left, is a paragraph: 'With AKCool® solar reflective granules you're choosing quality made in Germany. Amberger Kaolinwerke is a specialist in extracting, processing and refining of industrial minerals and has access to significant amounts of the highest-quality raw materials. This enables us to supply our products to markets around the world. Our AKCool® solar reflective granules are the result of more than 10 years of experience and continuous development work in the field of cool roof applications.' On the right side of the advertisement, there is another paragraph: 'Amberger Kaolinwerke is a member of the European Cool Roofs Council. This non-profit organization has set itself the task of promoting research and development of cool roof technologies and setting reliable quality standards for products and materials.' At the bottom right of the advertisement are two logos: 'MADE IN GERMANY' and 'ECRC EUROPEAN COOLROOFS COUNCIL'.</p> <p>Ex. E; <i>see also</i> photos in <i>id.</i> (showing AKCool granules layered on top of an asphalt/bitumen layer).</p>
1[a] at least one asphalt layer and at least one granular layer directly adhered to a top surface of the asphalt layer,	The AKW Products are intended to be applied, as a layer, directly on top of an asphalt or bitumen layer. AKW customers manufacture cool roofing systems including an asphalt layer and a granular layer, wherein the AKW Products are adhered directly to the top surface of the asphalt layer.



Ex. E.

Claim 1	
'512 Patent Claim	AKW Products
	 <p>Ex. E.</p> <p><i>See also</i> information for element 1[pre] above.</p>
1[b] wherein the granular layer comprises a plurality of highly reflective, calcined, bright white crushed kaolin particles	The AKW Products form a granular layer and comprise a plurality of highly reflective calcined, bright white crushed kaolin particles.



## Claim 1

## '512 Patent Claim

## AKW Products

 **AKCool® – PATENTED TECHNOLOGY**

The new, patented AKCool® granules are specially developed for bitumen mineral cap sheets used on roofs. The product is characterized by **permanently high reflectance values and especially long durability**. As a result, AKCool® helps lower building temperatures, minimize energy and operating costs, and meet building environmental standards.

**Optimized granules:**

- Completely reflective (due to reflective core material)
- Optimized flaked granule shape and ideal particle size distribution for perfect coverage and fixation
- High hardness
- Minimal fines, low dusting
- Absolutely UV-resistant

**Optimized surface:**

- Minimum staining thanks to highly hydrophobic and oleophobic surface
- Long term durability of granules brings long term reflectance to the roof system
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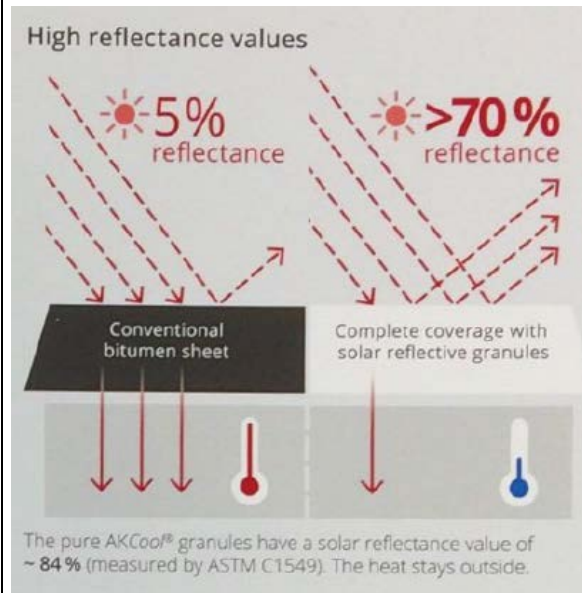

Flake shaped structure of AKCool®

AKCool® is coated to repel water and oil.

Ex. E.



Claim 1	
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	<p>The AKCool granules are disclosed as being “completely reflective (due to reflective core material)” and are claimed to be “patented.” Ex. E.</p> <p>“1. A roof coating comprising a bitumen layer with embedded particles, wherein said embedded particles comprise particles that are fired mixtures of  from 40 to 70% by weight clay minerals;  from 0 to 32% by weight crystalline silicas;  from 28 to 45% by weight feldspar;  from 0 to 15% by weight other aggregates,  wherein said fired mixtures have an open porosity of 0 to 14% by volume as measured according to DIN EN 993-1:1995.”</p> <p>'947 Patent, Claim 1.</p> <p>The Examples in the '947 Patent include China clay. '947 Patent, Example 1.</p> <p><i>See also</i> Complaint at ¶¶ 37, 39, 46.</p>
1[c] having a solar reflectance ranging from about 80% to about 92% prior to any added surface treatment,	<p>The AKW Products have a solar reflectance ranging from about 80% to about 92% prior to any added surface treatment.</p> <p>The AKCool granules are disclosed as being “completely reflective (due to reflective core material)” and having a “permanently high reflectance value and especially long durability.” Ex. E.</p> <p>“Pure” AKCool granules have a solar reflectance of ~84% as measured by ASTM C1549:</p>

**Claim 1****'512 Patent Claim****AKW Products****Typical product features:**

Property	Unit	Typical value	Test method
Solar reflectance	%	~ 84	ASTM C1549
Moisture content	%	≤ 0.5	DIN EN ISO 787-2
Water repellence	Min	≥ 120	ARMA Water repellency test
Hardness	-	≥ 7	MOHS
Particle size	mm	0.5 – 2.4	DIN 66165
Particle size	mesh	35 – 8	ASTM E11
Fines (< 150 µm)	%	≤ 0.5	DIN 66165
Fines (< 100 mesh)	%	< 0.5	ASTM E11

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	Ex. E.
1[d] wherein the surface treated, highly reflective, calcined, bright white crushed kaolin particles comprise crushed kaolin chamotte particles;	The AKW products comprise crushed kaolin chamotte particles.  <i>See, e.g.</i> , information provided for element 1[b] above.
1[e] wherein the surface treated, highly reflective, calcined, bright white crushed kaolin particles have a surface treatment consisting of a clear coating,	The AKW products have a surface treatment consisting of a clear coating.  AKCool granules are disclosed to include a surface treatment coating, and the core is disclosed to be “completely reflective.”

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**Optimized granules:**

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**Optimized surface:**

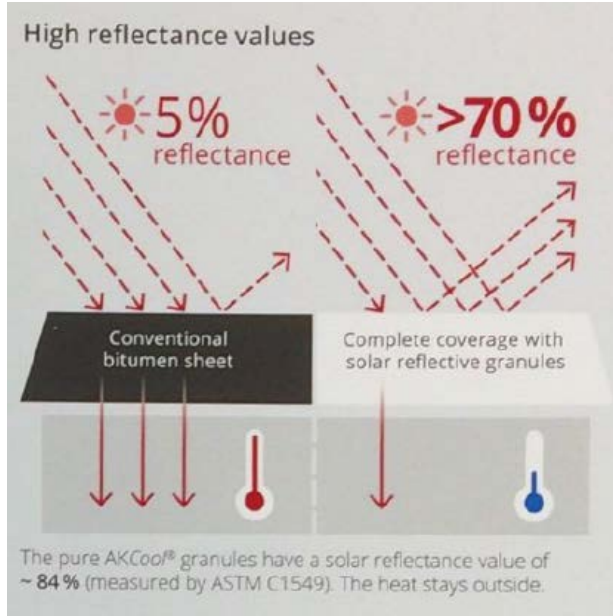
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Flake shaped structure of AKCool®

AKCool® is coated to repel water and oil.

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	The coating is thus clear.
1[f] wherein, when the surface treated, highly reflective calcined, bright white crushed kaolin particles are applied to the asphalt layer used for roofing materials, the surface treated, highly reflective calcined, bright white crushed kaolin particles have a resultant reflectance between about 70-82% and cover the top surface of the asphalt layer in the cool roofing system to provide a minimum solar reflectance of 70% or more; and	<p>When applied to an asphalt layer, the AKW Products have a resultant reflectance between about 70-82%, when covering the surface of the asphalt, and provide a minimum solar reflectance of 70% or more.</p> <p>The “pure” AKCool particles are stated to have a solar reflectance of ~84%, and they are shown to include a reflectance of &gt;70% when applied to fully cover an asphalt layer.</p>  <p>Ex. E.</p>

Claim 1	
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1[g] wherein the clear coating is selected from the group consisting of silanes, siloxanes, polysiloxanes, organo-siloxanes, silicates, organic silicates, silicone resins, acrylics, urethanes, polyurethanes, glycol ethers and mixtures thereof.	<p>The clear coating on the AKW Products is selected from the group consisting of silanes, siloxanes, polysiloxanes, organo-siloxanes, silicates, organic silicates, silicone resins, acrylics, urethanes, polyurethanes, glycol ethers and mixtures thereof.</p> <p>The '974 Patent indicates that the Example particles are coated with Unidyne TG-8111 from Daikin Chemical Ltd. which is fluoroalkly acrylate. The '974 Patent indicates that Unidyne TG-8111 coating was diluted with water in a 5:1 ratio, that the coating was applied at a maximum of 0.6% by weight of the particles, and that the reflectivity was not significantly deteriorated by application of the coating. '974 Patent at 3:64-67, 6:14-18.</p> <p><i>See also</i> Ex. E (product flyer).</p>

Claim 3	
'407 Patent Claim	AKW Products
3. The cool roofing system according to claim 1, wherein the clear coating improves adherence to the surface treated, highly reflective calcined, bright white crushed kaolin particles.	<p>The clear coating of the AKW Products improves adherence of the surface treated, highly reflective calcined, bright white crushed kaolin particles.</p> <p>The '974 Patent notes that the “adherence to the bitumen is not disturbed to the extent where the particles could become detached from the roof coating” and that “the particles are embedded in the bitumen matrix relatively firmly.” '974 Patent at 3:64-67, 6:14-18.</p> <p><i>See also</i> Ex. E (product flyer).</p>